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Management of a global spare part supply chain

Reconciling processes of the quotation phase with another location

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The thesis examines implementation of the most important functions of the quotation phase of the case company's service organization to operations of a plant in China.

The current state of the quotation phase was analyzed in both plants. The processes were studied from the perspective of a customer-orientated supply chain, and differences in organizational and cultural backgrounds were considered. As a result consistent practices for the most important functions were created to support both organizations' needs.

In the end major changes in the processes were not required. The quotation phase has been developed in the Finnish organization for a long time, and in recent years the policies and guidelines have also been documented. Traditions of the spare part quotation phase in China are short so improving and changing practices is fairly easy. The basis of the processes consisted of the same principles as in Finland, but the changes in the organization and differences in quotation offering had led to the fact that established and tested practices had not been formed.

The clearest weaknesses and the most awkward functions were settled within this project and the best practices were created. Spare part deliveries from China are expected to multiply in quantity and therefore the importance of both organizations will be remarkable in the future regarding spare part quotations. After the project it is important to hold on to the agreed rules and principles to ensure steadiness and faultlessness of the quotation phase. Processes are improved continuously and thus changes and development ideas should be acknowledged in both organizations and skills maintained on the required level.

Keywords	supply chain management, operations management, quotation phase, process implementation

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Insinöörityö käsittelee Metso Automationin Virtauksensäätö-liiketoimintalinjan Suomen palveluorganisaation varaosatarjousprosessin keskeisten toimintojen viemistä ja muokkaamista Kiinan tehtaan toimintoihin sopiviksi.

Tarjoustoiminnan nykytila analysoitiin molempien organisaatioiden osalta. Prosessien rakennetta tarkasteltiin asiakaslähtöisen tilaus-toimitusketjun näkökulmasta ja pyrittiin huomioimaan organisaatioiden ja kulttuurien väliset erot. Lopputuloksena luotiin tärkeimpien toimintojen osalta yhteneväiset toimintatavat, jotka tukevat kunkin organisaation tarpeita.

Suuria muutoksia prosesseihin ei lopulta vaadittu. Tarjoustoimintaa on kehitetty Suomen organisaatiossa jo pitkään, ja viime vuosina myös dokumentoitu toimintatapoja ja tehty ohjeita. Tarjousvaiheella on varaosien osalta Kiinassa vasta lyhyet perinteet, joten toimintatapojen muokkaaminen onnistuu vielä kohtalaisen helposti. Pohjana on ollut samat periaatteet kuin Suomessa, mutta organisaation muutokset ja tarjoustoiminnan eroavuudet ovat johtaneet siihen, että vakiintuneita hyväksi koettuja toimintatapoja ei ole muodostunut.

Selvimmät epäkohdat ja hankalimmat toiminnot saatiin tämän projektin puitteissa käytyä läpi ja parhaat toimintatavat luotua. Kiinan varaosatoimitusten määrän odotetaan moninkertaistuvan, ja siksikin molempien organisaatioiden varaosatarjoustoiminnan painoarvo tulee olemaan suuri. Projektin jälkeen on tärkeää pitää kiinni jo luoduista säännöistä ja periaatteista, jotta tarjoustoiminnan sujuvuus ja virheettömyys olisi varmistettu. Prosesseja kehitetään jatkuvasti, ja muutosten sekä uusien kehitysideoiden tulisi olla molempien organisaatioiden tiedossa ja osaaminen vaaditulla tasolla.

Avainsanat	toimitusketjun hallinta, toimintojen johtaminen, tarjousvaihe, prosessin implementointi

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1 Introduction

1.1 Background

Metso has a long history in Finnish industry. The company was formed from a small business to its current state as a global enterprise through several acquisitions over the years. The latest turn happened in the end of 2013 when the company was divided into two different independent companies: Metso Corporation and Valmet Corporation.

The potential of the after-sales and service business has not been historically used to its full extent. During the last few years the business has grown and greater focus has been put on service in general, and also in Metso. Still around 10 years ago service business of Flow Control business line was considered if not just the necessary evil, at most a thing to make customer happy. Currently service business is in a big role in any company when the growth is targeted to strictly contested industries. Service was part of the Global Operations in Metso Flow Control organization but was named a separate business line in 2011. The new strategy of Metso for 2014 - 2017 focuses on growing the service business.

Metso Corporation has decided on a new strategy and a new operating model, designed to drive growth in the company's core businesses and strengthen its financial performance and value creation. This will also help Metso to continue its transformation into a service and product-focused industrial player with attractive structural growth and high margin opportunities across its portfolio of services, products, and system deliveries. (Metso Corporation, 2014)

The spare parts team in Metso Automation Flow Control has served sales offices for decades and the team has evolved to the current state gradually. In the beginning the quotation phase consisted mainly of quoting the price and estimation of the delivery time for the requested spare parts. Nowadays these are still important functions but mainly automated. Engineers can instead concentrate on helping sales offices and further customers to find better solutions to extend the lives of their products. Practices in the quotation phase of the spare parts team have been developed with resolution during the past few years and currently the ways of working are quite efficient. Some of

the used practices can still be made better but there is a good and solid base to build practices on.

When Metso started to manufacture a selection of products in a new factory in Shanghai, China, in 2010, the spare parts operations still stayed in Finland. Plenty of work has been done in the Shanghai factory to standardize procedures and make the production efficient. Shanghai produces a growing percentage of products every year and delivers also small amounts of spare parts. It is in the interest of Metso strategy to offer backup on the spare parts business more evenly between Finland and the other factory in China to cover the global network of sales offices and further customers around the world.

The spare parts team in Finland has backed up the Shanghai team more and more during the past few years. Now there is a strong target to develop Shanghai spare parts operations to a level where they would be able to serve the Asia-Pacific region independently. Progress to that target was somehow under way already when this project was properly started in late 2013. Spare parts operations management in Finland has taken the process forward and to gain a deeper understanding of a quotation phase this thesis project was started.

At the beginning of the project the current ways of working in Shanghai were studied. The aim was to reconcile Shanghai procedures to ones used in Finland, so that the result would be the best way to serve the Asian market. When weak spots in the processes were recognized during the course of project, they were discussed in telephone meetings and more thoroughly in face-to-face meetings. The ideal result of the whole project would be that the spare parts team in Shanghai would be able to serve the sales offices and customers independently with backup of the counterpart team in Finland in the agreed work phases.

1.2 Limitations

The whole development project of managing the Shanghai spare parts operations to serve the Asia-Pacific regions as independently as possible consists of several areas of work, such as order handling, quotation phase, product planning, warehouse operations and shipping. The quotation phase is a small but an important part of it and re-

quires a deeper understanding than what managers can offer. This thesis is focused only on the quotation phase.

The quotation phase of the Shanghai spare parts team is not expected to be ready and perfectly arranged after the thesis project is completed. Developing the best practises is an ongoing project and co-operation between teams is essential in the future to keep the best ways of working updated in both offices. When a satisfying level is reached, this thesis will be considered to be ready and work will continue after that.

1.3 Structure of the thesis

In chapter 2 the theoretical background for the project is presented. The starting point for it is supply chain management in general and a more detailed view is studied from the view of outcome-driven supply chains. The idea is that in the future and even today a supply chain has to produce also other outcomes than just the traditional cost-related benefits.

The chapter 3 starts with an introduction of the case company. First the organization and important figures are presented. It is followed by a description of the project and explanation of what is tried to achieve and how. A current state analysis related to the project environment, including an overview of technical issues concludes the chapter.

Implementation of the project is described in chapter 4. The project plan and purpose of the project is viewed in more detail and solutions to each technical issue are explained thoroughly. The achieved results at the end of the project are presented. Also options for how to solve open issues are discussed.

Conclusions made during and after the project in chapter 5 complete the thesis before summary on chapter six.

2 Supply chain management

2.1 Supply chain management

Efforts of several organizations are needed before practically any product reaches the end user. These organizations are collectively referred to as the supply chain. (Handfield, 2011)

Figure 1 describes an example of a small supply chain of a component used in computer manufacturing.

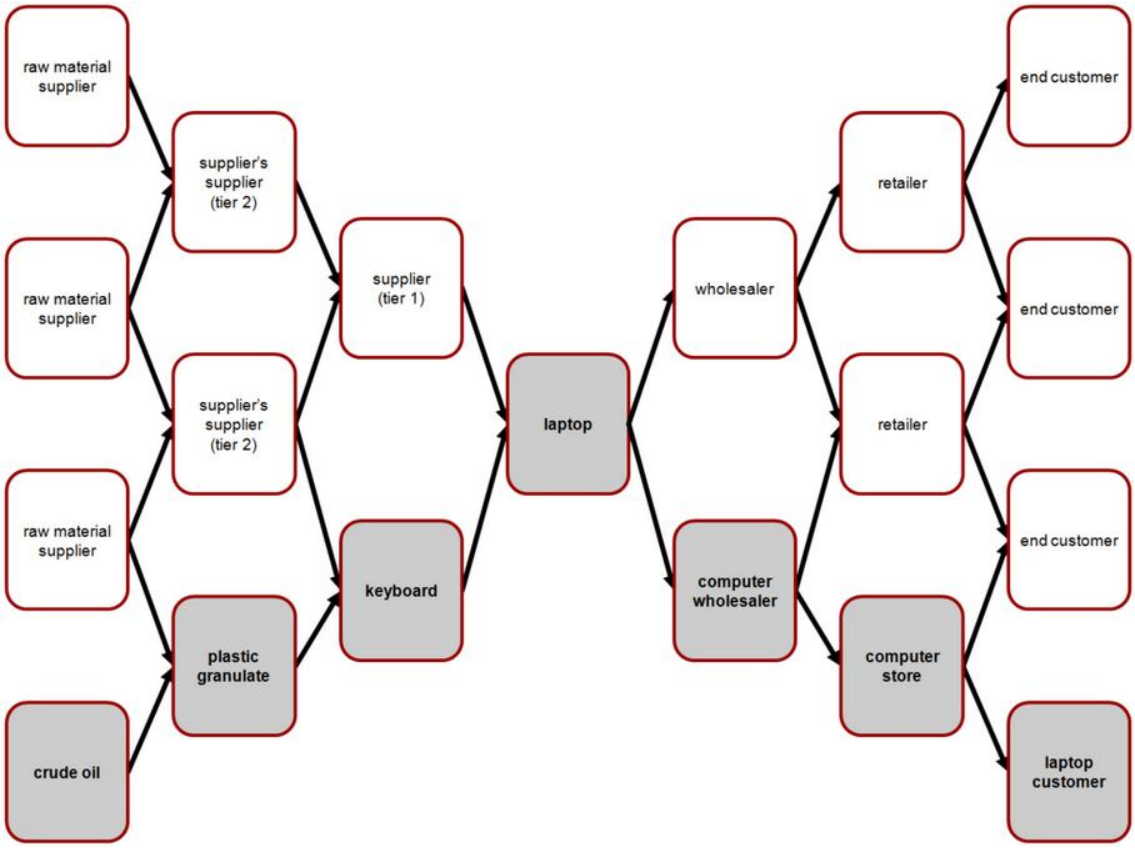

Figure 1. Example of a supply chain (Wieland & Wallenburg, 2011)

Handfield (2011) explains the broad issue of supply chain management briefly but comprehensively: “The concept of Supply Chain Management is based on two core ideas. The first is that practically every product that reaches an end user represents the cumulative effort of multiple organizations. These organizations are referred to collectively as the supply chain. The second idea is that while supply chains have existed for

a long time, most organizations have only paid attention to what was happening within their “four walls.” Few businesses understood, much less managed, the entire chain of activities that ultimately delivered products to the final customer. The result was disjointed and often ineffective supply chains. Supply chain management, then, is the active management of supply chain activities to maximize customer value and achieve a sustainable competitive advantage. It represents a conscious effort by the supply chain firms to develop and run supply chains in the most effective & efficient ways possible. Supply chain activities cover everything from product development, sourcing, production, and logistics, as well as the information systems needed to coordinate these activities.” (Handfield, 2011)

According to Abell (1980) supply chain management plays a big role in any company’s strategy: “In any industry, companies have to take a position on three strategic issues: Who is going to be the customer? What products or services should we offer to the chosen customer? How can we offer these products or services in a cost-efficient way? The answers to the "who-what-how" questions form the backbone of any company's strategy. In fact, some will argue that they are the strategy of a company.” The third question is what supply chain management is about.

Baldwin and Clark (2004) have been more creative when describing the idea: “If Supply and Demand were streets, you would set up shop where they meet. You would want to make sure that every customer who came through the door found what he wanted; at the same time, you would not want a cavernous stockroom full of slow-selling, slowly aging merchandise. Managing that balance - between maximum availability and minimum inventory - is one of a handful of truly critical factors in the success of a business.”

2.2 Outcome-driven supply chains

The research initiative "Supply Chain Management 2010 and Beyond" (Melnyk & Davis & Spekman & Sandor, 2010) studied supply chains with a four-year set of workshops and surveys. As a result it was discovered that traditional cost-related excellence is not enough to ensure a company’s success on supply chain management but five other outcomes have to be considered as well. The key customers’ needs must be studied carefully and a company has to arrange its supply chain so that all six aspects will be

addressed. The result should be a mix of all the six aspects where important outcomes to the customer have more weight and focus.

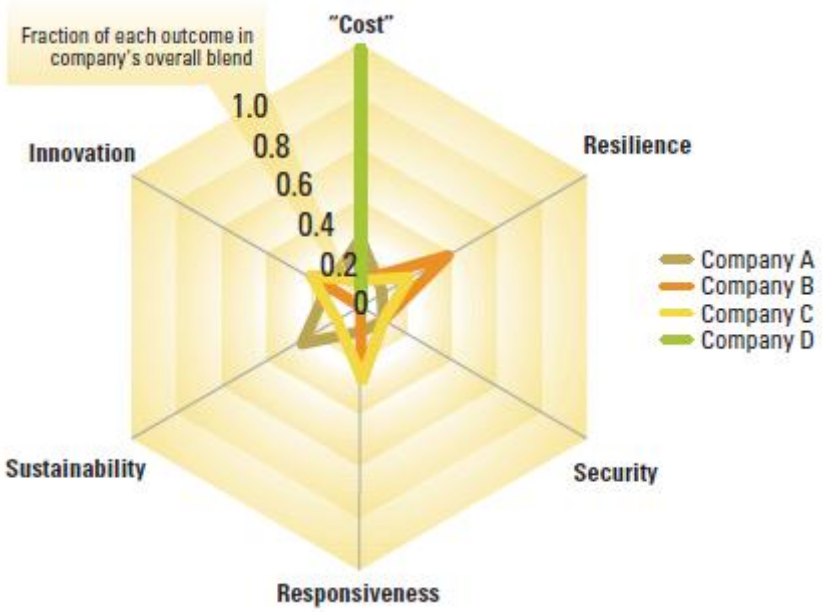

Figure 2. Blending supply chain outcomes to achieve competitive advantage. (Melnyk & Davis & Spekman & Sandor, 2010)

Figure 2 shows that Company D neglects all other outcomes except cost, which will result in poor overall performance because of lack of versatility. Companies A, B and C are well-prepared for changing conditions by creating a mix of all the six outcomes.

To serve customers well the whole supply chain must be thoroughly arranged to serve its purpose – the same supply chain will not be successful in all industries and for every customer. Levitt (1960) argued that businesses will do better in the end if they concentrate on meeting customers' needs rather than on selling products. "The railroads are in trouble today... because they let others take customers away from them because they assumed themselves to be in the railroad business rather than in the transportation business. The reason they defined their industry wrong was because they were railroad-oriented instead of transportation-oriented; they were product-oriented instead of customer-oriented."

That can be seen as the basis of outcome-driven supply chains – successful companies' supply chains are managed to serve customer-specific outcomes. Any of the six

outcomes should not be neglected but the best mix for one company might be poor for the other.

2.2.1 Cost

Decisions on supply chain management were long based almost solely on cost. Customers were interested in the price and efficiency rather than anything else. Melnyk, Davis, Spekman and Sandor (2010) argue that cost as a primary outcome means low monetary cost as well as good delivery and quality. This is what has been the most important factor traditionally and naturally still is one of the most important factors if a company wants to succeed. Hill (2000) summed up the importance as follows: cost is the order winner while delivery and quality are qualifiers.

Concentrating on operational performance offers ways to improve cost outcome. Reduced slack can be seen as the simplest way: smaller inventory, shorter lead times and high capacity all lead to more cost-efficient supply chain. Standardization must be applied wherever possible and reducing waste across the supply chain. (Melnyk & Davis & Spekman & Sandor, 2010)

Efficient supply management is another way to improve operational performance. Whether a company outsources or manufactures components can make a big difference – it can in fact differentiate a company from its competitors in price and quality. Company's profitability can depend on right choices in supply management. Cost is the most important driver in efficient supply management but if it is the only driver result can be poor quality or cost can even be multiplied in case an important component is in one supplier's hands - relying in single supplier can be dangerous. If such a supplier is crippled, a manufacturer can be left without critical parts. Some companies surveyed by a project team of Sheffi & Rice (2005) indicated that they are changing their procurement practices to ensure at least two or even more suppliers for each critical part. Using single supplier can also be the best solution cost-wise: other companies have cut the number of suppliers and deepened their relationships with a single supplier citing the benefits of core supplier programs, especially for outsourcing of highly engineered parts. (Sheffi & Rice, 2005)

Operational performance can be measured accurately and ways to improve it have been studied extensively. Kuula & Putkiranta & Toivanen (2012) studied how manufac-

turing sites have developed their operational management practices when their business environment changed. Environment changes in an increasing pace and therefore successful practices need to be changing as well. Bass diffusion model (Bass, 1969) is used on forecasting demand of new products. Early adopters act as test users and want the product even when the price is high – vast majority of consumers buy the product when it is developed further. Lifecycle of the product will come to an end when it is not highest technology anymore and more advanced products are published. New management programs are like new products: everyone wants one, but, before long, almost nobody does. On figure 3 Bass diffusion model is used to describe lifecycle of management paradigms and associated production methods.

Figure 3. Best practices by Bass diffusion model (Kuula & Putkiranta & Toivanen, 2012)

2.2.2 Responsiveness

Changing conditions may drive the ideal supply chain to be more responsive in terms of volume, location and mix. Responsive supply chain can deliver the goods when sales are as expected but can react well if changes in demand occur. Excess capacity in production as well as logistics gives room for maneuver in case demand gets high. Well structured information system is needed to spot changes in both directions: critical customers have to be monitored as well as state of supply of critical suppliers. (Melnyk & Davis & Spekman & Sandor, 2010)

The functions of a supply chain can be divided into two distinct types. The physical function is more visible and easier to measure: The raw materials are processed to components and eventually finished goods, and the products are moved from one

place to the next one. Market mediation is as important but less visible: supply chain must answer to consumers' needs and wishes. The purpose of market mediation is to ensure that right variety of products reach the marketplace. (Fisher, 1997)

Figure 4. Matching product with supply chain. (Fisher, 1997)

Another angle to responsiveness is to consider the nature of the product. When new, innovative products are launched to public the supply chain has to be responsive. In Figure 4 Fisher (1997) demonstrates this clearly: Functional product needs only an efficient supply chain because sales can be forecasted well and surprises are unlikely. Responsive supply chain would probably be more expensive option and benefits of supply chain would not be used in full. Forecasts for sales of an innovative product might be very inaccurate and therefore supply chain should be responsive. Sudden rise in sales can be reacted to by manufacturing and delivering bigger batches of products or reduce production in case sales are lower than expected.

Efficient supply chain is built and improved during the lifecycle of the product – if the product is functional then the lifecycle is probably long. On the other hand a responsive supply chain can be easily modified to something new if another innovative product is launched after the biggest profits of the previous one are collected.

Fisher (1997) uses a toothpaste as a good example in defining the nature of a product. His example of a manufacturer describes that higher profits could be reached by repositioning a product. “I found that 28 varieties of toothpaste were available. A few months later, when I mentioned this discovery to a senior vice president of a competing manufacturer, he acknowledged that his company also had 28 types of toothpaste - one to match each of the rival's offerings.”

A variety of 28 different toothpastes by one manufacturer is probably way too much. By managing a supply chain for less of a variety would move the product on figure 4 from right to left, from an innovative to a functional product. The supply chain would have to be efficient, not responsive – and a possibility for great savings would appear. Procter & Gamble, which has been simplifying many of its product lines and pricing, is coming to the conclusion that a smaller variety is enough. Toothpaste is a product category in which a move to the left - from innovative to functional - makes sense. (Fisher, 1997)

2.2.3 Security

Supply chains have grown in extent over the past decades and resulted in more complex chains than ever before. Sources of raw materials and components of a product can be from each continent and supply chain to the end customer can consist of tens of locations on the way. That leaves great possibilities for criminals to exploit weak spots of the supply chain – and a challenge for management to make the chain more secure.

Analyst David Schier from ABI Research is confident that improving security on supply chain adds to the value of a business as well. "Firms that can efficiently and securely transmit cargo information to the end user are well positioned in the container tracking market. Streamlining accurate shipping information into enterprise systems adds tremendous business value." (Frontline Newswire, 2005)

Cheviot (2010) sees that supply chain’s security is getting more attention and two factors inevitably continue to push the need to improve protection for the products: (1) the value and attraction for theft; and (2) pressure from the consumer to get their valued products to their destinations – yesterday. His answer to customers’ security concerns was to launch two programs that significantly made their supply chains more secure. High-risk program was developed to protect shipments that were considered valuable and exposed to risks - shipments were handled in each location with necessary care.

Program resulted in major business growth because high-risk shippers knew they could trust the supply chain. Reweigh process was developed to avoid loss of over-packed shipments during the logistical process by simply weighing the shipment on each location on the way to final destination. Small change in process resulted in remarkable improvement on security of supply chain.

There are several ways to make security better. Counterfeit drugs are a challenge in pharmaceutical industry and pacemakers of the industry have tried to tackle these challenges in different ways. Security seals, holograms and color-shifting inks are used in packages. Even machine-readable taggants are incorporated in the ink and can be read with a smart-phone application. Developing this kind of safety improvements can be costly but the risk of letting the business in wrong hands would result in much more costs in form of lost market share and customer confidence to counterfeit drugs. (Markarian, 2014)

According to a report from A.T Kearney (Frontline Newswire, 2005) executives believe that advanced technologies such as radio frequency identification (RFID) can enhance container security and improve visibility in the supply chain. A.T Kearney principal Omar Hijazi states that all along the supply chain, economic security and physical security are directly linked. "It now makes good business sense to improve security using advanced technologies such as RFID because of the associated benefits in operational and administrative efficiency. We found that most companies were already building a solid business case for deploying advanced technologies to solve the new-age issue of security and the age-old issues of reliability and efficiency." (Frontline Newswire, 2005)

A study in Material Handling Management (2006) reveals that companies that invest in supply chain security measures can expect benefits that outweigh the costs of the security expenditures, according to a new report by Stanford University. The companies all received the expected security benefits such as reduced vulnerability to global acts of terrorism, natural disasters and energy shortages.

Figure 5. “Collateral” benefits of supply chain security investment. (Material Handling Management, 2006)

They also documented significant “collateral” benefits as shown in figure 5. According to IBM in addition to lower risk and higher security, investments in supply chain security can provide significant business value to organizations by helping them to improve internal operations, strengthen relationships with their customers and overall increase their profitability. (Material Handling Management, 2006)

Risk management of supply chains is an important part of any international company in today’s business culture. Due to demanding customers and competitive pressures, businesses are restructuring themselves to operate globally to take advantage of the international product, factor and capital markets. Operating globally causes several concerns in economic, political, logistical, competitive and cultural point of view. Global supply chains are complex and require highly coordinated flows of goods, service, information and cash within and across national boundaries. (Mentzer, 2001)

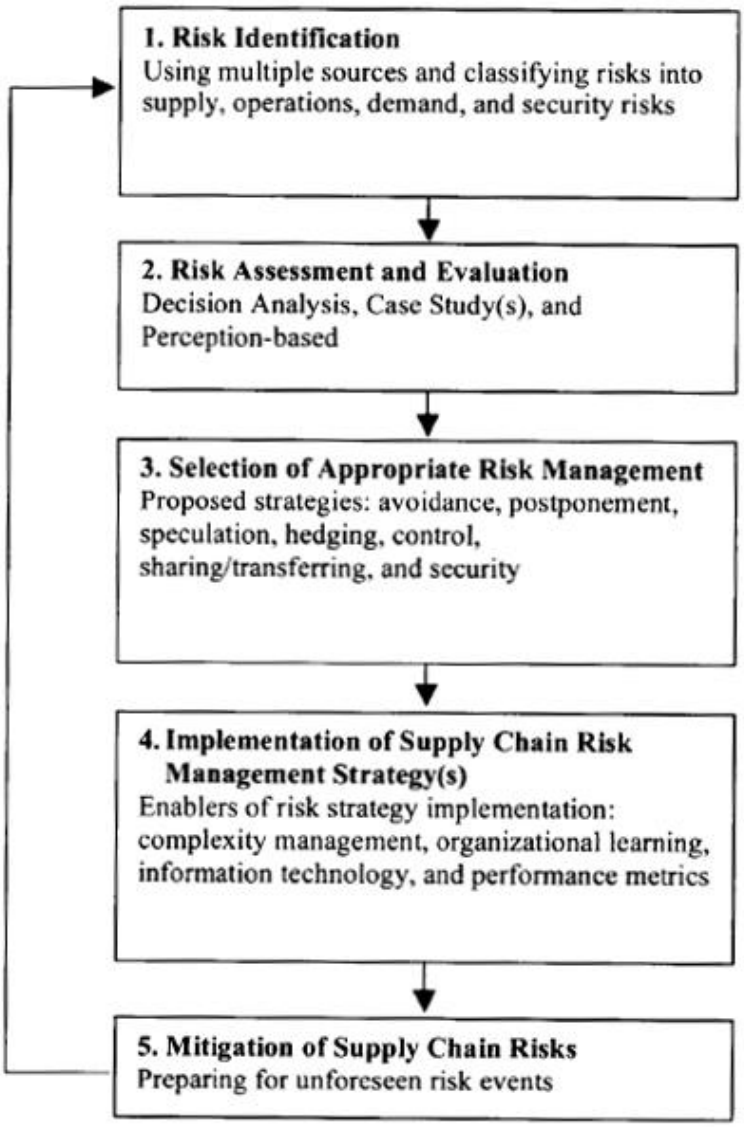

Figure 6. Supply chain risk management process (Manuj & Mentzer, 2008)

Manuj & Mentzer (2008) created a five-step process for global supply chain risk management. After risks are identified and evaluated, supply chain risks can be mitigated by using different strategies described in figure 6 steps 3 and 4.

2.2.4 Sustainability

Social responsibility and environmental awareness has grown in importance remarkably over the past years. Sustainability was not in the center of attention in the early years of globalizing businesses but common interest in well-being of the planet has changed thinking of companies especially in the developed countries. Sustainability in

company's supply chain also benefits its economy as well: energy usage is a strong example of caring about the green values but at the same time cost savings. Less used energy means less costs and environmentally sustainable thinking. That can also mean more sales because customer can opt to buy a product from sustainable supply chain rather than a company that neglects the green values. According to Field (2008) shareholders and customers have been increasingly clamoring for companies to make their supply chains more eco-friendly. Professor Hau Lee Thoma from the Stanford Graduate School of Business tells that five years ago boards were asking management, "what's our China strategy?" but today they want to know about their green strategy. (Field, 2008)

The public image of a company is one issue and real actions is another one, also what comes to social responsibility. Marketing can create an image of a green company while actions might be different. Studies show that environmental sustainability is one of the top priorities for growing number of companies. A PricewaterhouseCoopers study of over 500 executives from around the world found that 42% of respondents considered environmental sustainability to be "highly important". (Inside Counsel, 2013)

Although growing attention environmental issues is nothing new in global business. It has been studied already decades ago. Arie de Geus (1997) described a study conducted by Shell in the early 1980s of companies that had survived for more than 200 years. What those organizations had in common was an understanding of themselves as a human community first and a machine for making money second. That can be seen as one proof of sustainable values to be also important business-wise and not only for building an image of sustainable company.

One of the biggest companies to announce sustainability as an integral part of supply chain management was Wal-Mart. CEO Lee Scott stunned the business world in 2005 when he told a meeting of more than 1,000 suppliers and other partners that environmental sustainability must become a central part of the company's formidable supply chain operations. The goals included everything from doubling fuel efficiency over the next decade to eliminating 30% of energy use in stores. And, the company would start taking such steps as evaluating suppliers on the environmental acceptability of their packaging and using those assessments to make buying decisions. (Field, 2008)

Sustainable aspect of supply chain can be created in many ways. Saving on energy costs is probably the most popular one. While making a good name for the company it also results in big cost savings. Rising fuel costs and global business environment forces companies to re-consider supply chain thoroughly: production facilities near customer and going from outsourcing back to manufacturing on their own reduces shipping costs.

Small decisions can also play a role in making a supply chain more sustainable. Aligning incentives in a Canadian bread manufacturer's case helped them to save money as well as environment. Deliverymen were offered commission for keeping shelves filled with manufacturer's bread – even on days when competitor gave huge discounts on their products. The Canadian baker had to throw away heaps of stale loaves while deliverymen earned good commissions. Well designed incentive scheme can make its share on sustainability – and save money. (Narayanan & Raman, 2004)

2.2.5 Resilience

Supply chain might be working perfectly well for periods of time even if resilience was not considered to be an important outcome. Eventually lack of resilience will damage business in the long run. All the other outcomes will make supply chain better in every sense but resilience gives peace of mind when problems occur. Resilient supply chain will recover faster from disruptions caused by natural disasters, social factors, medical emergencies, economic setbacks or technological failures and is more efficient when some part of the chain breaks. (Melnyk & Davis & Spekman & Sandor, 2010)

Pettit, Fiksel and Croxton (2010) created a measurement tool to help building resilient supply chain. Vulnerability factors (fundamental factors that make an enterprise susceptible to disruptions) listed on table 1 cover most of the imaginable disruptions. By evaluating these risks and contemplating them with capability factors (attributes that enable an enterprise to anticipate and overcome disruptions) listed on table 2 resilience can be obtained.

Table 1. Vulnerability factors. (Pettit & Fiksel & Croxton, 2010.)

Vulnerability factor	Definition	Subfactors
Turbulence	Environment characterized by frequent changes in external factors beyond your control	Natural disasters, Geopolitical disruptions, Unpredictability of demand, Fluctuations in currencies and prices, Technology failures, Pandemic
Deliberate Threats	Intentional attacks aimed at disrupting operations or causing human or financial harm	Theft, Terrorism/sabotage, Labor disputes, Espionage, Special interest groups, Product liability
External Pressures	Influences, not specifically targeting the firm, that create business constraints or barriers	Competitive innovation, Social/Cultural change, Political/Regulatory change, Price pressures, Corporate responsibility, Environmental change
Resource Limits	Constraints on output based on availability of the factors of production	Supplier, Production and Distribution capacity, Raw material and Utilities availability, Human resources
Sensitivity	Importance of carefully controlled conditions for product and process integrity	Complexity, Product purity, Restricted materials, Fragility, Reliability of equipment, Safety hazards, Visibility to stakeholders, Symbolic profile of brand, Concentration of capacity
Connectivity	Degree of interdependence and reliance on outside entities	Scale of network, Reliance upon information, Degree of outsourcing, Import and Export channels, Reliance upon specialty sources
Supplier/Customer Disruptions	Susceptibility of suppliers and customers to external forces or disruptions	Supplier reliability, Customer disruptions

Table 2. Capability factors (Pettit & Fiksel & Croxton, 2010)

Capability factor	Definition	Subfactors
Flexibility in Sourcing	Ability to quickly change inputs or the mode of receiving inputs	Part commonality, Modular product design, Multiple uses, Supplier contract flexibility, Multiple sources
Flexibility in Order Fulfillment	Ability to quickly change outputs or the mode of delivering outputs	Alternate distribution channels, Risk pooling/sharing, Multisourcing, Delayed commitment/Production postponement, Inventory management, Rerouting of requirements
Capacity	Availability of assets to enable sustained production levels	Reserve capacity, Redundancy, Backup energy sources and communications
Efficiency	Capability to produce outputs with minimum resource requirements	Waste elimination, Labor productivity, Asset utilization, Product variability reduction, Failure prevention
Visibility	Knowledge of the status of operating assets and the environment	Business intelligence gathering, Information technology, Product, equipment and people visibility, Information exchange
Adaptability	Ability to modify operations in response to challenges or opportunities	Fast rerouting of requirements, Lead time reduction, Strategic gaming and simulation, Seizing advantage from disruptions, Alternative technology development, Learning from experience
Anticipation	Ability to discern potential future events or situations	Monitoring early warning signals, Forecasting, Deviation and near-miss analysis, Risk management, Business continuity/preparedness planning, Recognition of opportunities
Recovery	Ability to return to normal operational state rapidly	Crisis management, Resource mobilization, Communications strategy, Consequence mitigation
Dispersion	Broad distribution or decentralization of assets	Distributed decision making, Distributed capacity and assets, Decentralization of key resources, Location-specific empowerment, Dispersion of markets
Collaboration	Ability to work effectively with other entities for mutual benefit	Collaborative forecasting, Customer management, Communications, Postponement of orders, Product life cycle management, Risk sharing with partners
Organization	Human resource structures, policies, skills, and culture	Accountability, Creative problem solving, Cross-training, Substitute leadership/empowerment, Learning/benchmarking, Culture of caring
Market Position	Status of a company or its products in specific markets	Product differentiation, Customer loyalty/retention, Market share, Brand equity, Customer relationships, Customer communications
Security	Defense against deliberate intrusion or attack	Layered defenses, Access restrictions, Employee involvement, Collaboration with governments, Cyber-security, Personnel security
Financial Strength	Capacity to absorb fluctuations in cash flow	Insurance, Portfolio diversification, Financial reserves and liquidity, Price margin

As important as to reach resilience is to avoid over-focusing on these capabilities. By doing so the company will be lead to erosion of profits as illustrated in figure 7.

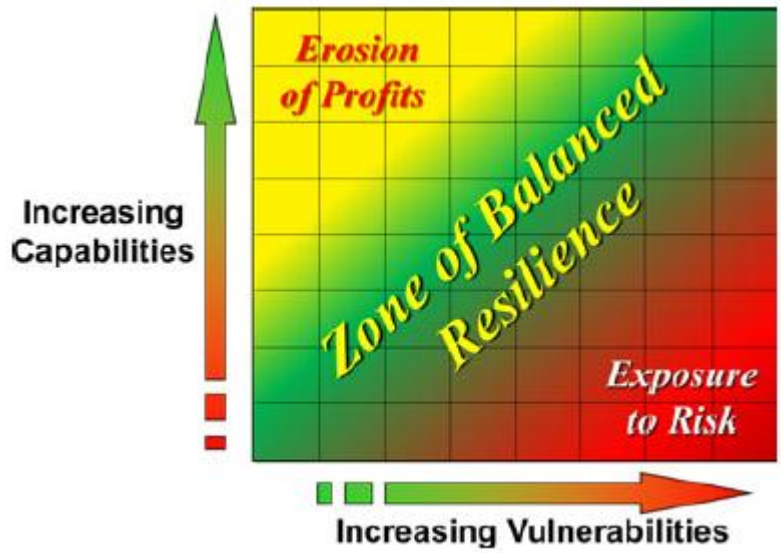

Figure 7. Resilience fitness space (Pettit & Fiksel & Croxton, 2010)

A supply chain works well if its companies' incentives are aligned - that is, if the risks, costs, and rewards of doing business are distributed fairly across the network. (Narayanan & Raman, 2004)

Managing the risk of an uncertain future is a challenge that requires resilience - the ability to survive, adapt, and grow in the face of turbulent change. (Pettit & Fiksel & Croxton, 2013.)

2.2.6 Innovation

Innovation is a joker of all the six outcomes. It can bring something new to a company or change course of it completely. Innovation requires slack in many phases of supply chain to enable new ways of producing, delivering or distributing products and bringing completely new ideas to use. Close cooperation with suppliers as well as critical customers uses more resources but can lead to new innovations because more aspects of the business are considered. According to Melnyk & Davis & Spekman & Sandor (2010) suppliers can also be viewed as sources of “near innovations” by solving problems in other markets before using the gained knowledge to address current customer needs. Also during early stages of product development it is important not to use specific performance metrics so as not to stifle innovation.

When it comes to strategic innovation, the big challenge for small firms or new entrants is coming up with new strategic ideas. On the other hand, the big challenge for established companies is organizational: they need to develop the culture, mind-set, and underlying environment to continually question current success while promoting continual experimentation. Underpinning all the successful strategic innovators examined was a specific mind-set that encouraged dissatisfaction with the status quo and demanded ongoing soul searching. Ultimately, those companies that strive for self-renewal will succeed in the long term. (Markides, 1998)

Strategic innovation occurs when a company identifies gaps in the industry positioning map, decides to fill them, and the gaps grow to become the new mass market. Gaps can mean 1) new emerging customer segments (or existing customer segments that other competitors have neglected), 2) completely new emerging customer needs (or existing customer needs not served well by other competitors) and 3) new ways of producing, delivering, or distributing existing or new products or services to existing or new customer segments. The first requirement for becoming a strategic innovator is to identify gaps before everybody else does. (Markides, 1997)

Sometimes being innovative means to start thinking from the beginning the whole business the company is in. In any industry, companies have to take a position on three strategic issues: Who is going to be the customer? What products or services should we offer to the chosen customer? How can we offer these products or services in a cost-efficient way? The answers to the "who-what-how" questions form the backbone of any company's strategy. In fact, some will argue that they are the strategy of a company. (Abell, 1980)

One will never discover new lands if one does not venture outside the safety of the harbor. Similarly, you will never discover new ways of playing the game if you don't question the way you currently play. A prerequisite for strategic innovation is a fundamental questioning of the way we do business today. It means actively thinking about the business and perhaps mentally experimenting with a few "whys" and "what ifs." This is difficult for any company to do but it is almost impossible for a successful one. Needless to say, trying to change in the middle of a crisis is the worst time to do so. It is much better to think about the business in a proactive, long-term way when times are good. Established companies that want to strategically innovate must take the time to

question the way they do business, especially when they are successful. They should not wait for a crisis to start contemplating the future. (Markides, 1998)

Significant shifts in market share and fortunes occur not because companies try to play the game better than die competition but because they change the rules of the game. Breaking the rules is one way to play the game. All firms should not adopt it, and they should not adopt it all the time. Whether a company should break the rules depends on factors such as the nature of the industry, the nature of the game, the industry payoffs, the firm's competitive position, and so on. The strategy is, by definition, risky. Yet a company can manage the risk, primarily by experimenting in a limited way or limited area before fully adopting the new strategy. (Markides, 1997)

3 Company introduction

Metso was created through the merger of Valmet and Rauma in 1999. Valmet at that time was a paper and board machine supplier, while Rauma's operations were focused on fiber technology, rock crushing and flow control solutions. The merger produced an equipment supplier serving the global process industry. Soon after the merger, Metso Corporation started to build its mining offering by acquiring Svedala Industri AB. Following an active acquisition and organic growth strategy, Metso soon became one of the world's leading process industry suppliers.

The year 2013 marked a special turning point in Metso's history when the decision was made to split the company into two listed, independent entities: Metso Corporation and Valmet Corporation. The latter continues the history of Valmet by serving industries that use bio-based raw materials. Metso focuses on intelligent solutions and services for the mining, construction, and oil and gas industries. Metso also continues to provide process automation and flow control solutions and services for the pulp, paper and power generation industries as well as selected other industries. Metso's shares are listed on the NASDAQ OMX Helsinki Ltd.

Metso published a new strategy in July 2014.

"Under the new strategy, Metso's core customer industries will be mining, oil&gas, and aggregates. Metso's goal is to strengthen its position as the leading technology and services provider for end-to-end minerals processing and to become a leader in flow control within the oil&gas and mining industries.

As part of its new strategy, Metso will study strategic alternatives, including potential divestment, for its current Process Automation Systems business, which primarily serves the pulp, paper, and power industries.

Metso's new strategy and operating model will underpin its transformation into a focused company with businesses that are largely driven by its customers' production activities. Metso's goal is a business model, where more than 50% of activities consists of services, products account for a sizable proportion of net sales, and system deliveries concentrate on proprietary technology that supports its future services business.

This type of portfolio will offer the opportunity for positive long-term profitability and resilience to the cyclicality typical of Metso's customer industries."
(Metso Corporation, 2014)

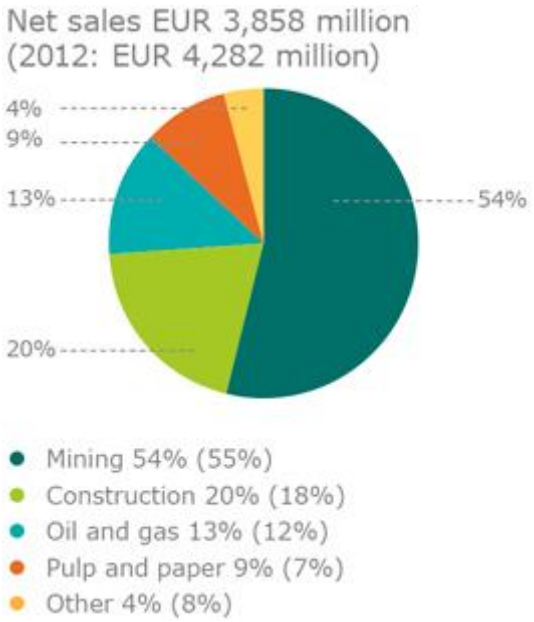

Figure 8. Net sales by customer industry in 2013. (Metso Annual Report, 2013)

Metso is divided into two reporting segments:

- Mining and Construction (78% of net sales in 2013)
- Automation (22% of net sales in 2013)

The year 2013 was successful for Automation. The demand for products and related services to the energy and oil and gas industries remained good and the segment recorded its highest-ever annual order intake in 2013. The demand from pulp and paper customers remained satisfactory.

The annual orders received totaled EUR 902 million, which is 7 % more than in 2012 (EUR 845 million). The order intake improved in all the segment businesses. The emerging markets accounted for 44 % of new orders. The services order intake increased by 10 %, or 14 % using comparable exchange rates, compared to 2012 and accounted for 47 % of all orders received.

Net sales for 2013 as a whole declined 1 percent compared to 2012 and totaled EUR 854 million (EUR 859 million). Net sales improved 2 percent in the Flow Control business and declined 14 percent in the Process Automation Systems business. Net sales

in the services business increased 5 percent and accounted for 47 percent of the segment's net sales (44%). (Metso Financial Statements 2013)

Figure 9. The operating profit and EBITA of Automation before non-recurring items. (Metso Annual Report, 2013)

3.1 Flow Control

According to a new integrated industrial operating model since October 2014 Metso Automation's business lines are Services, Minerals and Flow Control. Minerals and Flow Control's financial performance is reported externally.

The Flow Control business line is divided into Oil and Gas, Pulp and Paper, Services, Valve Controls and Mining Flow Control.

3.1.1 Facilities

The traditions of Metso Flow Control are rooted in Finland. Before the factory in Vantaa was built, Metso and its predecessors operated in Helsinki since the 1950s. Metso's new industrial valve factory in Vantaa, Finland, was officially opened in September 2011. The location is logistically ideal, being close to the Port of Helsinki, the Helsinki-Vantaa Airport and two main highways. The adjoining office building houses project management, research and development, global service development, customer training as well as management and administration of the Metso Flow Control business unit.

The acquisition of an American flow control manufacturer Jamesbury occurred in 1988. The American factory still produces Jamesbury brand products. The new factory in Shanghai was opened in 2010. It was designed to produce Neles brand products – the same products that are produced in Finland – but only the volumes and product selection was different. Since then the same procedures used in Finland are implemented in production in Shanghai. Slowly production has grown and management has covered more important tasks in the factory.

During recent years, Metso has done a series of investments in its global valve offering and presence. In 2012 Metso announced acquiring a globe valve technology and service company, Valstone Control Inc. in South Korea, inaugurated a new supply and service center in India, and completed expansion of its valve production premises in the US. Metso also has high-class industrial valve facilities in Brazil and Germany.

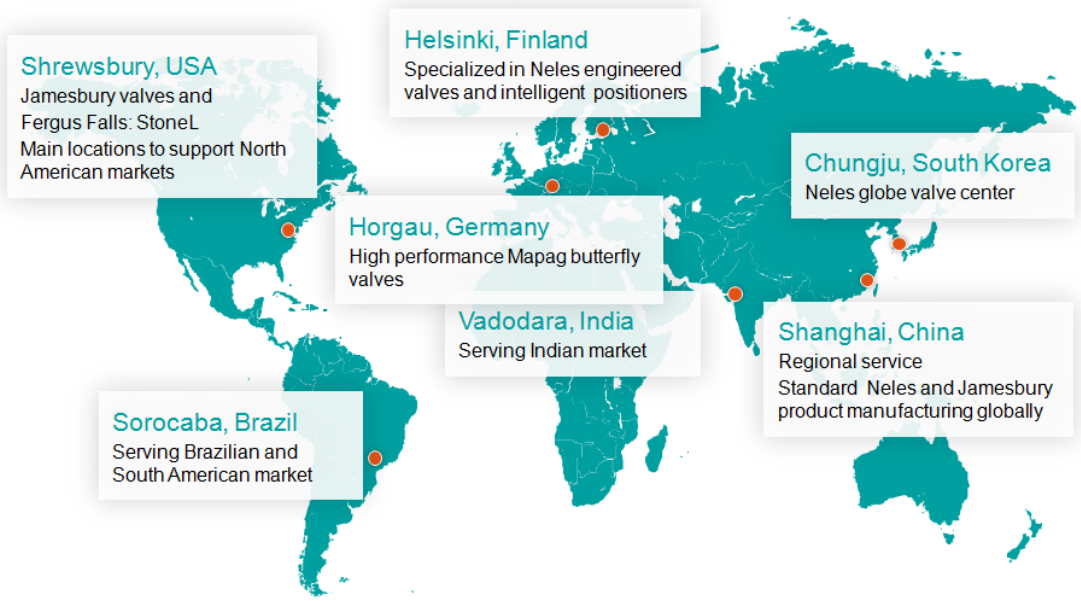

Figure 10. Global valve operations network (Automation General Presentation 2013)

The other facilities of Flow Control are scattered around the world in strategically important locations. Several service centers serve customers in their area and sales offices cover the world even more thoroughly. The factories have their own fields of specialization product- and technology-wise but also based on location.

Figure 11. FC service centers locations. (Automation General Presentation 2013)

When the Shanghai factory was founded, the idea was to share the production load but also centre the distribution of the products to Asia-Pacific region. Nowadays the Shanghai factory produces most of the high volume products, so the Vantaa factory can focus on products that are special and are more sensitive to failures. The importance of the Shanghai factory has grown during the years since it was founded in 2010.

3.1.2 Services and spare parts operations

The spare parts team and quotation support operate under the spare equipment and parts in Vantaa. The operations team is responsible for spare part deliveries to other factories, service centers, sales offices and customers around the world. The main functions are maintaining spare part data with product management, spare parts quotations, order handling, production planning and picking of spare parts for orders. Three quotation engineers answer to the sales offices' internal quotation inquiries which are based on customer needs recognized by sales offices. Based on internal quotations and information found in databases, the sales office places a customer order which is processed by two order handlers. The production planner is responsible for distribution orders from the factory to the spare part warehouse and work orders to the picking team. Based on the work order, the picking team in the spare part warehouse prepares the customer order by making purchase orders to suppliers, doing the manufacturing orders and picking all the items on customer order.

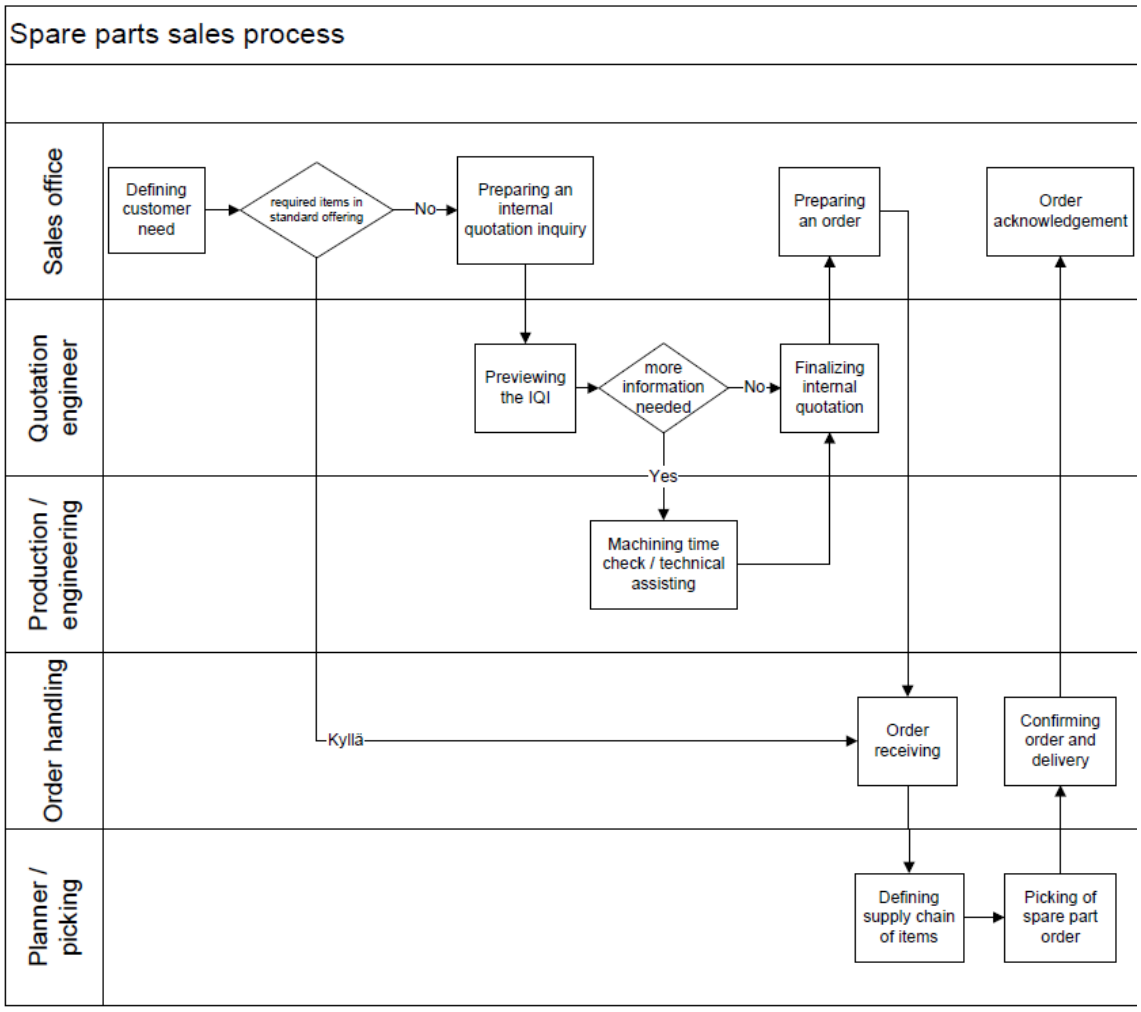

Figure 12. Spare parts sales process.

In the Shanghai factory the spare parts operations have always been managed differently. Spare parts have been delivered along with complete products. The whole process used for delivery is the one used for complete products on the day-to-day business. The responsible person has been the manager in charge of the day-to-day business but that person has not been able to concentrate on or develop spare part deliveries.

In Metso's strategy service business is given more attention than ever before and the target is to grow globally more strongly in after-sales than in other businesses. Security in the supply chain has always been a priority – service technicians can service their own products better than customers' technicians and risks associated with unoriginal spare parts will be avoided. Unoriginal spares can be of poor quality and lead to major problems at the customer site. The quality of spares cannot be ensured only by deliver-

ing spares to one's own products – the whole supply chain of the spare parts must be monitored. According to Melnyk, Davis, Spekman and Sandor (2010) emphasis should be placed on control through certification and extensive auditing. Also a limited number of partners is important to deny entry points for a possible threat. Metso's strategy to have skilled professionals and availability of high quality spares supports this theory.

3.2 Objective of the project

The target of the project is to arrange processes in the Shanghai factory so that they will be able to handle China and APAC regions' spare parts operations independently. There are several reasons to implement the project. The company strategy supports global presence especially in the service business, and the spare part center in China would cover an important and big market. Although volumes have been low, on-time delivery has also been weak because the spare part business needs a more agile supply chain than the one used for complete products. By transferring and copying processes from the Finnish spare part team a good and solid base can be created.

Reaching the target would mean improvement on several of the outcome-driven supply chain's (Melnyk & Davis & Spekman & Sandor, 2010) outcomes. Sustainability might be the biggest winner. Spare part selection would be much better and that would lead to deliveries being shipped to the Asia-Pacific region's customers mainly from Shanghai. Currently items are often manufactured in Shanghai but shipped to Finland and forwarded again to the Asian market. Resilience is another outcome that will be stronger: two factories will be almost equally capable to ship spare parts globally in case one of the supply chains had severe problems.

The primary target is to arrange spare part operations so that Shanghai would be working independently but in co-operation with Vantaa to serve all the sales offices and, through them, the end-customers. Spare part deliveries have been made in a mixed way – some Asian sales offices still prefer deliveries to be done from Vantaa because of long traditions, existing contacts and the idea that a high level of skills are available. In the bigger picture the target is to push China and APAC region sales offices to use only resources in Shanghai for spare part inquiries and deliveries.

3.3 Current state analysis in the Shanghai factory

Organization in the Shanghai factory is much smaller than in Vantaa and is headed by the plant director. Under him there are managers for different valve streams, actuators, materials, sales support and machining. Spare parts in the Shanghai are handled by the day-to-day sales support team. Before spare parts quotations and deliveries were handled in Vantaa but the target has been to make Shanghai's role bigger in the whole supply chain of the spare parts business along with day-to-day orders.

In the beginning the director of spare parts solutions was more involved when the process of change was started to make the Shanghai factory self-sufficient in the spare parts business. As the process progressed further it has mainly been organized by the Vantaa manager for spare parts operations. The first substantial step was taken in December 2013 when the manager of the Shanghai factory sales support team was designated to head Shanghai spare parts operations. Already before that spare parts were delivered from the Shanghai factory according to day-to-day processes but work to build their own team and processes for spare parts was started then.

3.3.1 Defining delivery times

Internal quotation inquiries (IQI) are sent by sales offices. One of the most challenging parts of handling IQIs is to find the correct spare parts for each valve or actuator but also the price and delivery time of each item have to be quoted.

Quotation engineers in Shanghai are trained well and are basically as capable of finding correct parts as their colleagues in Vantaa. Information has to searched from old databases in many cases and sometimes help from engineering is needed. Technical knowledge and skills are already on a very good level and IQIs sent to Shanghai spare parts team are almost completely prepared there.

Lead times of items are longer than what same items to be quoted in Vantaa. One understandable reason is that in Shanghai spare part warehouse there are much fewer different items stocked than in Vantaa – many items have to be ordered from Vantaa spare parts warehouse FFA. Another reason is that order handling and production planning are done according to day-to-day processes and therefore the shortest possible delivery time is two weeks. Also the historical fact that before spare parts were

picked from around Shanghai factory warehouse by someone who does picking of complete products caused the delivery time to be at least two weeks.

There are no fixed delivery times in the sales database for any spare parts delivered from Shanghai. That is one of the reasons why sales offices prefer to order items from Vantaa even if Shanghai would be geographically closer and the delivery time might be shorter.

Shanghai uses one potentially useful parameter in ERP that Vantaa does not use. Parameter ABC class in ERP separates different kinds of spare parts into groups according to delivery times and that parameter is not used in Vantaa FFA. One sign means one group of delivery time (e.g. F = 1 to 2 weeks, G = 2 to 4 weeks etc.) and might have been helpful when exact delivery times have been difficult to determine.

3.3.2 Pricing

The Global Reference Price (GRP) is used in internal quotations to sales offices. The customer price depends on the level reduction factor which varies between different countries and products. GRPs are quoted in both Shanghai and Vantaa, and most of the items are already priced in the sales database. Many of the missing GRPs are available to quotation engineers in a file that is managed and updated in Vantaa but available in both offices.

Spare parts consist of around 60000 different items and roughly 20000 are priced. The items that are not priced already are quoted daily in the Vantaa office. Most of the inquiries for older valves that are more difficult to quote are sent to Vantaa. Those inquiries include often items that are not priced, and before internal quotations can be made, GRPs have to be calculated. Also some of the newly designed valves include completely new components and those have to be priced as well. New designs are often quoted from the Shanghai office, so spare parts occasionally need pricing in these cases as well.

There are three types of spare parts from the pricing point of view.
- Parts for the Neles brand are priced value-based
- Parts for the Jamesbury brand are based on the cost quoted by the US factory
- Parts for 3rd party products are based on the supplier’s quotation

The process for Neles pricing has been clear and simple: Vantaa does all the pricing. When Shanghai quotes a new item or an old one has no price, a request to Vantaa will be sent for pricing. Pricing for Jamesbury parts has also worked well: Shanghai has the same connections to the US factory as Vantaa, so the GRP can be calculated with certain factors based on the US quote Shanghai receives. The most difficult ones are the 3rd party products because purchasing is done in both factories on different continents. A quotation used to calculate the GRP in Shanghai can be totally different from the one used in Vantaa. Also the same spare part can go by two different names and descriptions in different offices, so duplicate items might end up in the company systems. Both offices have priced the items themselves with similar factors but the GRP can be different in the end because of different quotations.

3.3.3 Product data management

Spare part items as well as other items are firstly created in the master database Aton and after it is done in ERP called M3. Both factories use both systems. Shanghai engineering creates new items in Aton including 3rd party spare part items. New Neles items that are only used as spare parts are only created in Vantaa.

In Shanghai factory only one warehouse is used in M3 (HBA). Because of that spare parts team is not allowed to enrich items in M3 or change any parameters. If a parameter is changed in HBA it would affect the whole factory. People who do not work with spare parts are responsible for enrichment of spare parts in HBA. That might cause some conflicts but so far the process has worked well and fast enough.

The most unclear area has been 3rd party items – how and who should create the items and enrich them. There have been no rules as to how it should be done and currently it is unclear to all involved. Basically both factories can ask for local suppliers' quotations and sell an item to a customer based on that quotation. Usually a 3rd party item is new to all systems and has to be created in Aton and enriched in M3 (even if an item is quoted and created before it might have been created with a different description). Shanghai has done it so far themselves by a person who does not work with spare parts. One problem is that the whole order of spare parts will be shipped from Vantaa but items created by Shanghai are not enriched in the Vantaa spare parts warehouse FFA. That will stop the order in M3 until enrichment is done and delivery will be late.

Another problem is that item data in Aton is done in a very mixed way because there has been no training in Shanghai. The current and proven way of working in Vantaa has not been documented, partly because the problem of two offices creating items was not realized before.

3.3.4 Project quotations

Spare part quotations for customer projects are also done by spare parts teams. Normal internal quotations are for customer need in the case of a shutdown, breakdown or similar event. Project quotations are made for new projects. The customer wants a quotation for servicing the products in scope and the sales office asks for spare parts for all products. There is really no process to quote spare parts for projects. Normal internal quotation inquiries are made by the procedure and replying to them is standardized in both offices. Projects consist of bigger quantity of units and are therefore more demanding in terms of the working hours needed. That is the main reason why a normal IQI-process cannot be used.

In Vantaa some kind of rules have been created to avoid obscure requests from the project unit. Still different formats are accepted but not just anything can be sent as a request. The process could be and should be better to make it more straightforward and simple and the requests understandable. The Shanghai project unit is responsible for most of the Asia-Pacific project quotations and the Shanghai spare parts team prepares spare part quotations to those projects. Work between Shanghai and Vantaa spare parts teams is often somehow shared because of pricing and enriching so also Chinese project quotations are remotely familiar to Vantaa quotation engineers. Shanghai project unit and spare parts team prepare their quotations in varied Excel formats. That might cause problems when third party is mixed into working on it.

4 Implementation of the project

4.1 Project plan

Metso Automation's main factory has always been in Finland and other factories have been supporting it in one way or another. Currently the factory in the United States is focused on the Jamesbury brand. The Shanghai factory was built only a few years ago and it has been producing the same brands and basically the same products as Vantaa. The difference is mainly that Shanghai is concentrating on standard high volume products while Vantaa is specializing in technically more demanding products.

The Shanghai factory has been raising its importance in Metso's global strategy since the factory was started. Special products are and will be delivered from Vantaa but the long-term target is that Shanghai would be able to make most of the deliveries to the Asia-Pacific region. The Spare Parts business has not been the most urgent issue to organize because it could still be handled from Vantaa. However according to the strategy also spare parts should be available from Shanghai as easily as from Vantaa and now the topic has come up with more weight.

4.1.1 Purpose of the project

The Shanghai factory was started in 2010 but the spare parts business has continued to be managed in Vantaa - the main factory - until now. This project was started with a target to make Shanghai spare parts operations independent and self-sufficient to cover the Asia-Pacific market area. Spare parts have been delivered along with complete products by day-to-day procedures in Shanghai and the purpose of the project is to arrange deliveries and the supply chain to be faster and more agile to serve spare part deliveries better. To implement this change, the processes and best practices of the Finnish spare part team were decided to be brought to China.

The processes of the spare parts operations in Vantaa are continuously improved. However during the last years operations have worked well and no major changes have been made. Now most of the processes and best practices used in Vantaa would be copied and modified to suit Asian market and the factory in Shanghai. Differences in volume, size and skills of team as well as working culture make some of the processes

used in Vantaa poorly usable in Shanghai and should not be implemented as they are. The organization of the Shanghai plant and the spare parts team are much smaller than the ones in Vantaa so some of the resources must be divided with other teams to form an efficient way of working for all the people involved.

The actions towards the target were started at the end of 2013. Progress has taken place already earlier but systematic actions were undertaken then. A relatively small but an important part of the project is the quotation phase. The scope of this thesis is reconciling best practices with the ones used in Shanghai.

4.1.2 Timeline

The Project to accommodate the Shanghai office better to serve spare parts deliveries was started already in 2013 and will be worked on until an acceptable level is reached. The official target when the project should be ready was not set in the beginning but the task list is followed and the milestones are documented during the project progress.

The quotation phase was included in the whole plan of integrating the Vantaa ways of working to the Shanghai factory from the beginning but was not given much attention before the early months of 2014 and the start of this thesis project.

4.1.3 Responsibilities

The manager of the Vantaa spare part operations is responsible for carrying the project through. He reports to the director of the spare parts solutions. The responsible person for the spare parts operations in Shanghai was named in December 2013.

In January 2014 a quotation engineer from the Vantaa spare parts team participated in a meeting between Vantaa and Shanghai counterparts. Already then one project engineer and a quotation engineer from Shanghai were involved in the project.

4.2 The actions taken

After the project was started, telephone meetings were arranged between the two offices on at least a monthly basis. Meetings were more frequent when new topics

emerged or a follow-up had to be done to some of the planned actions. The follow-ups covered the procedures that were launched in Shanghai and needed supervising. If there were no problems with any of the launched procedures, the technical details or general issues regarding the spare parts business were discussed. The quotation engineer in Vantaa was and still is the main contact for the Chinese counterparts, so questions with quotations always exist.

The manager of the Vantaa spare parts operations visited the Shanghai factory several times during the course of the project. Topics included issues on all the spare part-related areas such as supply chain, delivery issues, organizing of the spare parts warehouse and production planning. The manager who is responsible for the Shanghai end also visited Vantaa regarding the same issues.

The quotation procedures and issues had only been discussed in telephone meetings where quotation engineer from Vantaa participated. In June 2014 also the quotation engineer visited the Shanghai factory where one week was used to arrange the quotation phase for the Shanghai engineers among all other spare part-related issues. Then the procedures were discussed and instructions for the quotation phase were reviewed in greater detail. It was left for the Shanghai office to implement all the procedures and to arrange follow-up telephone meetings. Also another visit to Shanghai will be done if necessary.

After an acceptable level of working is reached in Shanghai, applying the best practices in the quotation phase will continue and the improvements in the ways of working will always be implemented in both factories.

4.2.1 Defining delivery times

The starting point is to review how the delivery times are defined in the Vantaa Spare Parts warehouse which is derived from the factory warehouse. In ERP system M3 the names of the warehouses are FFA for the spare parts and FBA for the factory. All the items that require processing are manufactured in FBA and DO’s (Delivery Orders) from FBA in FFA parameters.

Distribution Order lead time is calculated with a formula:
Material purchasing lead time + machining + 11 days buffer. If the material is a safety stock item, the material purchasing lead time is zero but another buffer of 5 days is added so that the factory can arrange production. Items that are purchased in FBA but that do not need machining are also DO's to FFA with purchasing lead time rounded up to the next five.

Purchase Orders are easy to determine: the purchaser defines the lead time according to the delivery time in the supplier's quotation.

Manufacturing Order in the spare part warehouse FFA basically means a spare part set or a seat set – the lead time depends on the components' lead times. Also some strips are MO's and the lead time for those is the same as for the sets that all the components can be picked from the spare parts warehouse - two days.

Item Category	Description	Example	Case	PTF
PO-Item	Purchased FFA	63470		Lead time
DO-Item	Part from FBA/FBB	H039852	Safety stock	5 days
			No safety stock	FBB lead time + 2 + 0 to 4 days *
DO-Item	MO (Picked set with MO parts)	H059032	All set components have safety stock	5 days (product structure)
			All components don't have safety stock	Longest FBB lead time (component)/ PTF+ 2 + 0 to 4 days *
DO-Item	MO (Machined)	978100	Safety stock (main item)	5 days
			Safety stock (all components)	Lead time + 5 (buffer) + 9 (safety) + 2 + 0 to 4 days *
			No safety stocks	FBB lead time (main item) + FBB lead time (component) + 9 (safety) + 2 + 0 to 4 days *
MO-Item	Sets DO-part from FBB/FFA	250516	All set components/set have safety stock	2 days
			All components don't have safety stock	Longest FFA lead time (component)/ PTF + 2 + 0 to 4 days *
MO-Item	Sets picked from FBA	H057412	All set components have safety stock	2 days
			All components don't have safety stock	Longest FBA lead time (component)/ PTF + 2 + 0 to 4 days *

* Round up PTF to fives (for example 42 + 0 to 4 = 45 or 30 + 0 to 4 = 30).

Table 3. Defining lead times in FFA warehouse

The basis for how to determine the Shanghai spare parts lead times is ideally to do it the same way as in Vantaa but would have to be modified to Shanghai needs. The biggest difference is that in Shanghai the spare parts do not have their own warehouse in ERP – the parts in the spare parts physical warehouse are included in the inventory of the whole Shanghai factory warehouse HBA but are defined a location within the spare part section of the factory warehouse.

The basic rules for defining the lead times in FFA are described in table 3. That table can be used for HBA MO's and PO's in Shanghai as well but the differences caused by

only one warehouse in ERP should be noted. The lead time for DO's can be calculated by adding ten days for transportation to the FFA lead time. If an item is enriched in FBA but not in FFA it should be considered case by case what would be the delivery time for that item. Options are that the item is

- DO directly from FBA to HBA. Then different transportation times apply
- the item should be enriched in FFA first and the lead time would be calculated according to table 3

One big difference in the whole ordering process between the factories is that majority of the Internal Purchase Orders (IPO) sent to Vantaa are based on Product Data Management system (PDM) and the sales offices can find there all the necessary information to place an order. PDM was not launched and used in Shanghai so all of the items that the sales office wanted to order needed an internal quotation from the quotation engineers. Adding the delivery and price information in PDM for the Shanghai deliveries as well would make the ordering process much easier and faster. Also work load of the quotation engineers would be smaller.

4.2.2 Pricing

Most of the spare part items are already priced. The whole price list is checked by spare part product management annually and more often when there is a reason to expect changes in some product group costs. The product management is responsible for the quoted prices in the end but the quotation engineers do the practical work.

Pricing is not a simple issue because there are different kinds of cases where different rules apply. On the previous chapter three different types of spare parts pricing was recognized.

Neles brand spare part pricing is best described as value plus cost-based. There is a long history for pricing of the parts and the knowledge has grown enormously. Pricing is difficult because many different types of items have to be priced: cost for a purchased item is relatively easy to get from ERP but an item that is machined of a casting requires more work to find the information of cost. The information can also be incomplete or even false and that have to be spotted to avoid significant mistakes.

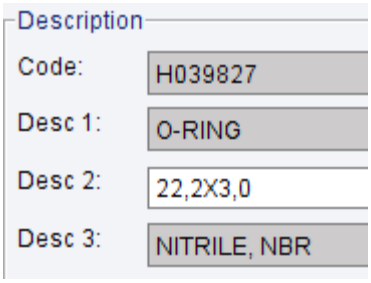

Figure 13. Data of every item including id code and three descriptions.

Pricing has to be also value-based – similar items have to be comparable to each other. Figure 13 shows an example of an item. All of the items are created with three descriptions: item type (shaft, o-ring etc), a more precise description (e.g. valve type and /or dimensions of the item) and material of the item. Similarity of an item means that the item type is the same, the material is the same and in the best cases second description is the same except the size of the item or a valve is different. Table 4 shows an example of four similar items where the only difference between the items is size of each valve the seat ring is for.

Table 4. Example of four similar items.

ID_CODE	ITEM_DESC1	ITEM_DESC2	ITEM_DESC3
644393	SEAT RING	L1C14H	UNS N07080+HCr
644383	SEAT RING	L1C10H	UNS N07080+HCr
644373	SEAT RING	L1C06H	UNS N07080+HCr
641293	SEAT RING	L1C08H	UNS N07080+HCr

If reliable information for the cost from ERP can be found, another challenge will be to set the price to fit between other similar items when comparing the prices. The cost might not be in line with other similar items, so some creativity is needed to set a well-balanced price. Occasionally information on the cost cannot be founded but an item can be priced if many similar items are priced already by comparing the prices of other items.

The most challenging case for pricing is when an item is not similar with any previously priced item by the material or the more precise description. The price has to be calculated based on the information on cost and if that does not exist in ERP, a supplier's quotation have to be requested from the purchasing organization. There lies the next challenge: Spare Parts Operations do not have proper connections to the suppliers and

the purchasing organization of the factory has to be used. Another variable comes up when the supplier's quotation is received: the unit price for 1 or 2 pieces can be double than for 3 to 10 pieces and even 10 times bigger if 100 pieces are ordered. An item that is ordered from the supplier only to be used as a spare part is typically ordered in small quantities so defining the cost of an item is not always a simple issue.

Because of the above mentioned reasons the rules for pricing are difficult to create. The expertise in Vantaa is high and the traditions long. Each quotation engineer uses their own methods when pricing the items but the basic principles are respected. The product management is responsible for pricing so they will set the price if the quotation engineer is unsure what should be quoted.

The engineers dealing with the spare parts in Shanghai are skilled professionals. Currently pricing for the Neles parts is done in Vantaa but there is no doubt that the Shanghai engineers would be able to learn to do the pricing as well as their colleagues in Vantaa. However the learning process would require quite a long time of daily instructing. Because of the distance it is impossible to arrange proper training for the Shanghai engineers. If training was arranged, there would also be a risk that the engineers involved with the spare parts in Shanghai would change to other duties and that would bring the process back to start. Pricing has always been done in Vantaa and it has beem decided to keep it that way for the foreseeable future.

Jamesbury brand spare part pricing is based on the cost quoted by the US factory. Shanghai has the same connections to the US factory and both Shanghai and Vantaa are quoted the same prices. The easiest way to calculate the GRPs is that both offices request their own quotations and calculate the prices with the agreed multipliers.

3rd party product spare part pricing is based on the supplier's quotation. A multiplier is agreed so there are no obstacles for both offices to quote the prices on their own. Problematic is product data management with 3rd party products. If these challenges can be settled 3rd party spare parts can be priced like the Jamesbury spare parts.

4.2.3 Product data management

Earlier all the spare part items were created in the master database Aton in Vantaa. From Aton the items were transferred to ERP M3 and enriched there for the spare

parts warehouse FFA. All the items in FFA are either PO, MO, or DO from the factory warehouse FBA. When the Shanghai factory started, Shanghai only enriched the items they needed in M3 Shanghai warehouse HBA. When engineering / R&D started in Shanghai new items were also created there. The process for new items enriching is different than for the spare parts – new items are enriched when an order for the item is sent. Spare parts have to be enriched in an earlier phase, preferably when the item is quoted. In that way faster service can be guaranteed and on-time delivery is on a better level. The process to enrich the items in the quotation phase was started in June 2014.

In Shanghai spare parts enriching is done by a person outside of the spare parts organization because in Shanghai there is only one warehouse HBA and the enrichment for the HBA items is done elsewhere. No plans for the spare parts warehouse in Shanghai ERP-wise are made and probably the enrichment will continue the way it is done now. The spare parts team has been happy with the process so far. That leaves the Shanghai quotation engineers the responsibility to check that all the items they quote are enriched in HBA, FFA or both. If the item is purchased locally there is no need to enrich it in FFA. The enrichment in FFA is needed if the item is DO from FFA or if an internal purchase order will be sent to Vantaa.

From the spare parts point of view the clearest way to differentiate the different kind of items is to consider how it is acquired: whether it is purchased locally, manufactured locally or distributed from another factory.

4.2.3.1 Manufacturing order (MO)

In Vantaa there is different warehouse for the factory (FBA) and the spare parts (FFA) so all the processed metal parts are manufactured in FBA and are DO's in FFA. Because there is only one warehouse in Shanghai (HBA) the most common item is a processed product which is manufactured in Shanghai from purchased material. All of these items are used in the complete units so they are created in the master database Aton by the engineering in each factory. Spare part use is secondary and the enrichment is done by the factory personnel in charge of enrichment in FBA and HBA.

The most common MO item in FFA is a spare part set or a seat set. Both include several components considered essential when servicing a unit. These sets are created in

Aton by the spare parts team and more precisely the quotation engineers when quoting an item. Also the enrichment in M3 is done at this point of the supply chain. The components included in a set are picked from FFA stock or are directed to FFA from FBA and are picked to complete set.

All the sets are created in Aton by the Vantaa quotation engineers. The reasons are mainly the same as with pricing: the long traditions in Vantaa which would cause a difficult training issue if implemented in Shanghai as well as a possibility for several mistakes when creating an item in the master database.

Regarding the sets in HBA there can be three types of cases concerning ERP.

1) DO from Vantaa when none of the included components are stocked in HBA.
MO would mean that all of the included components were ordered from FFA (DO). There is no sense to do that because if the set is DO, then only one DO will be needed. If the set is considered important, creating safety stocks for each component in HBA should be considered.

2) MO when all the included components are stocked in HBA.
When enriching a set the easiest scenario in HBA is that all the items are stocked. Components included in a set can be picked from HBA warehouse.

3) MO when some of the included components are stocked in HBA and some components are DO from FFA.
If some of the included components are safety stock items and some are DO from FFA it is basically the best to order the set completely from FFA (DO) to avoid confusion. In some occasions MO can be an option and also creating a safety stock to all the components should be considered if the set is sold in high volumes.

In FFA some of the strips used in the spare part sets are cut from a roll of sealing strip. In ERP also these items are MO. Similar items exist in HBA as well and the complete rolls should be considered to be used as material of the strips.

4.2.3.2 Distribution order (DO)

On previous chapter one clear case of DO was described: spare part set or seat **set when none of the included components are safety stock items**. It is better to order the complete set from Vantaa.

Processed metal parts are manufactured either in HBA or the Vantaa factory FBA. Mainly standard items are manufactured in high volumes in Shanghai where the manufacturing is cheaper. The more special items are manufactured in Vantaa and are often used in old units as spare parts. If a processed metal part is not manufactured in HBA it must be DO from FFA. DO can be also from FBA but the delivery process is different and is not suitable for the spare parts.

Third group of DO items for Shanghai are items **that are purchased in Vantaa**. These items can be purchased locally as well but is often not feasible because the consumption in Vantaa factory is high and therefore the costs low. Certain product groups are decided to be always purchased and it is up to the Shanghai purchasing department to optimize whether an item is purchased locally or DO from Vantaa. One thing to consider is the fact that some customers accept only products manufactured in Europe.

All DO items from FFA must be enriched in FFA first. Before Shanghai can quote an item it has to be enriched in FFA – the orders with items that are not enriched will be stopped in M3. Depending on item, the enriching might take up to one week and the order will be stuck until the enrichment is done.

The enrichment in FFA is done by the Vantaa quotation engineers. Basic rule is that there are responsible persons for enriching in each warehouse (HBA, FFA, FBA). That way the amount of mistakes and possible problems can be minimized – everyone are specialists and responsible for their own warehouse. That basic rule should be applied.

4.2.3.3 Purchase order (PO)

The Shanghai factory has its own small purchasing organization. Naturally many of the used items are purchased locally rather than shipped from Finland after being purchased from a Finnish supplier. All of the items that the Shanghai factory purchases

and uses in complete units can be used as spare parts as well. Because there is only one warehouse in ERP (HBA) these items are PO before the spare parts team even considers the way of acquisition.

Jamesbury brand spare parts are quoted and delivered by the US factory to both Vantaa and the Shanghai factories. The Shanghai-Vantaa delivery route is considered factory-to-factory business where the items are moved between factories freely (DO) without selling the item to another factory. Jamesbury brand and the US factory is different: the items are sold to factories for the cost price (PO). Shanghai buys the Jamesbury items directly from the US so in M3 the Jamesbury items are PO in HBA.

Some certain soft parts used in the complete units are purchased locally and can be used in the spare part sets as well. The spare part sets sold in Shanghai include also items that are not used in Shanghai current production and are therefore DO from FFA. Some of these items can possibly be purchased locally as well.

The most challenging group of the items that could possibly be PO are **3rd party** spare parts. The customers' installed base consists of products of several manufacturers. One unit can consist of a Metso Valve, a competitor's actuator and a Metso smart device. Spare parts for the valve and the smart device must be ordered from the Metso sales personnel and often in this kind of cases the actuator spare parts are requested at the same time from the Metso personnel. The Metso purchasing organization can buy also the competitors' spare parts.

Earlier all the 3rd party spare parts were created, enriched and quoted by the Vantaa quotation engineers. Now that Shanghai quotes the spare parts as well, the procedures are not very clear. The enrichment in HBA must be done still by the Shanghai quotation engineers but finding the correct spare parts from the already created 3rd party items is very challenging. The Metso personnel in neither Vantaa nor Shanghai are specialized in 3rd party products so creating the items correctly in the master database Aton depends on the information on supplier's quotation and the experience of the quotation engineer to spot the important information from the quotation. Probably many identical 3rd party spare part items are created in Aton and enriched in M3. That is because when a new internal quotation inquiry for 3rd party product is handled, the information on the supplier's quotation might look very different.

The more the engineers create new 3rd part items, the more mixed will the result be. In an ideal situation all the 3rd party items would be created in one place – the best practices would be developed, improved and executed by one group of professionals. On the current situation the only party capable of taking the responsibility on the issue would be the Vantaa quotation engineers. One downside of this procedure would be the workload caused – Vantaa would be doing all of the work that could be possibly done by each engineer if instructed properly. Another downside would be slowing down of the quotation phase in Shanghai – all the new 3rd party items requested from the Shanghai quotation engineers would have to be requested from Vantaa colleagues.

Currently 3rd party items are created also in Shanghai by a person who is not involved with the spare parts otherwise. The results have been quite poor: the items are created in a very different way than other similar items and inconsistently. Also the enrichment in M3 is not done at all. The created item is quoted to the customer in Shanghai and ordered through Vantaa but the item is not enriched – the order will be stuck before the Vantaa personnel enrich the item.

Current procedure creates too many problems, is not efficient and therefore cannot be continued. Purchasing these items in Shanghai should be promoted because it would not improve only the cost outcome (Melnyk & Davis & Spekman & Sandor, 2010) but also the responsiveness and the resilience of the supply chain. The suppliers in both Europe and Asia would be able to handle the customers globally better and sourcing in both continents would affect the cost outcome remarkably, especially in the low-cost countries in Asia.

If prepared properly the most efficient and easiest solution for all involved would be to create the items independently in both factories. A significant challenge to get that procedure working is to arrange training so that everyone creating 3rd party spare part items would be able to follow the same process. The training would not take weeks so the possibility to arrange training either in Shanghai or Vantaa would have to be checked. One day training between the Shanghai and Vantaa quotation engineers, the person responsible for enriching in Shanghai and the purchasers of 3rd party spare parts from both factories would be a perfect option. That includes probably too many people from each factory to make a meeting possible. The most important persons to make the training worthwhile have to be found out and try to arrange a meeting either in Shanghai or Vantaa.

4.2.4 Project quotations

One engineer has prepared basically all the spare part quotations for the projects in Shanghai for several years. The way quotations are prepared is probably the best way in all aspects for her – one person has controlled the process and improved it during the years. The process is not documented and not known in Vantaa. The project units in both offices work independently but processes for spare parts quotations should be considered and possibly standardized. Co-operation between the spare parts teams reaches the project quotations as well and therefore similar ways of working would be important.

The instructions for the Vantaa project unit regarding the spare part quotations request were introduced to whole project unit of Vantaa and have been in use for roughly a year. The procedures have been much better than before – in many occasions the spare parts quotation engineers have been more involved through the project and not only been requested the spare part quotation with undefined instructions. Still incomplete requests arrive and getting everyone in project unit to work by the instructions is one challenge. Another issue to consider is that no-one from the quotation engineers who handle the project quotations were fully involved on creating the instructions and the Shanghai office do not even use the instructions. Created and used instructions were a step forward but the process for the project spare parts quotations still needs fine tuning.

The process is well structured and at least a good starting point for further improvements. There are a few issues to consider.

1) All the requests for theproject spare parts are sent via mail to the quotation engineers' supervisor, the manager of the spare parts unit. In that way the supervisor has a good understanding of the current situation regarding the project quotation requests. Earlier the requests were sent to some of the quotation engineers, normally the most experienced engineer would receive the most requests because the person is well-known in the project unit. Clearly the best way would be a database or a system where the project unit could enter a request and the spare parts team could reply to it on the same place. That way everyone involved in the project unit as well as the quotation engineers and their supervisor would be able to follow the situation in real time.

2) The needed information is fully covered if the current instructions are used. However the form of the work file is not limited. The customers usually want their project quotations on their own files and forms no matter how old or non-functional they may be. Naturally that form might not be negotiable. Different kind of excel files, lists, forms and browser-integrated applications have to be used in project unit. All the forms have always been accepted in the spare parts team and the traditions are difficult to break. The current system causes an engineer specialized on the spare parts to be wrestling with different applications rather than concentrating in one's core competence. The ranges of responsibilities between the project unit and the spare parts team should be discussed.
3) A request type can be the spares for start-up, commissioning, one year's spare or two years' spares. Categories of the spare parts selection are defined for each type. Different request types should be checked and what is included in each category reviewed with the product management. Recommendations what to include in which type has changed since the instructions were created.

There is no proven ready-made process in either of the factories. The Vantaa instructions are a good starting point for discussion - the best practices of both factories would be combined in the most efficient and constructive way in a workshop in either of the factories. Prior to the workshop some of the issues such as categorization of the spare parts should be settled. The workshop should involve the quotation engineers, the manager of spare parts unit and the spare parts product manager. Also the spare parts unit manager and the project unit counterparts should discuss how the project quotations will be processed.

4.3 Results

Standardizing processes in the Shanghai Spare Parts team is an ongoing project. It has been a subject of continuous improvement since the plant in Shanghai was built. This project has been progressing steadily since it was started with full effort in 2013 and will continue until an acceptable level is reached.

The quotation phase gained more attention in February 2014 and is naturally a much smaller subject than the whole spare parts business. Most of the issues are discussed already now but the implementation of some of the improvements is under work. New issues have risen and will rise during the course of the project and even though the

quotation phase is quite strictly limited topic the idea of continuing improvement of the ways of working guarantees that the quotation phase will never be ready.

4.3.1 Improvements in the Shanghai Spare Parts organization and delivery issues

The first step was to name a person to lead the spare parts team in Shanghai. The organization and spare parts volumes are much smaller in Shanghai than in Vantaa so full-time personnel was not considered to be needed at this point. The sales support manager from the day-to-day business was named in December 2013 to lead the standardization project in Shanghai. Later on a quotation engineer from project unit was named to handle the Asia-Pacific area quotations as well as the spare parts quotations for the projects. Another quotation engineer from day-to-day business was named to take charge of the spare parts quotations in China area. One sales coordinator from day-to-day was named to take care of the spare part orders. All the above mentioned personnel are shared resource with their own organization. Also two full-time picking personnel were hired to be in charge of the spare parts warehouse and picking of the spare parts orders. The team is measured for significantly smaller volume of spare parts business and so far the team has been able to serve their purpose well. Production planning for spare parts is still done by a person who does other planning tasks at the factory. The spare parts business requires faster actions in planning and a planner to work part-time only for the spare parts is still to be named and trained.

The delivery times of the spare part orders were very long in the past because the delivery process was done by the day-to-day business model. The spare parts business requires much faster reacting – a leaking valve or a burned unit cannot wait for weeks to receive the spare parts. After the personnel were named the basic principles in the delivery process for faster service were launched. The sales coordinator used to add two weeks on the delivery time for picking, packing and other needed actions according to the day-to-day process. The new procedures guaranteed that an item can be shipped in two days after receiving an order if an item is stocked. After this step was taken order lead time follow-up was started. In the beginning of following up the on-time delivery was unacceptable but with further improvements it has reached good a level and stayed there.

The spare parts were not considered when the warehouse in Shanghai was planned originally. The picking area was arranged and the spare parts locations were estab-

lished to structure the spare part deliveries better. The picking personnel is now in charge of maintaining the warehouse in ERP and physically. The stock items were determined and safety stock levels set. Some of the items are moved only from other locations at the factory to the spare part location and some items are distributed from Vantaa to keep the safety stock level. Further improvements on the physical stock are made continuously by the picking personnel together with the managers if needed. The safety stock items and the stock levels are being monitored by the managers to keep the warehouse functionality at its best.

4.3.2 Standardized processes in the quotation phase

Important improvements to standardize the quotation engineers' work are already done. System-wise the most critical issues are fixed and general feeling is that now the available information can be trusted. Fixed offering was created in March 2014 meaning that items to be stocked in the Shanghai spare part warehouse were decided. All the spare part sets and seat sets are gone through and defined whether they should be Manufacturing Orders or Distribution Orders from Vantaa. Also predefined delivery times of all items in the Shanghai warehouse are now fixed and updated.

The quoted delivery times are much shorter now because the delivery process is improved. The quotation engineers are not allowed to modify any items in ERP because the Shanghai warehouse is controlled by the factory personnel whereas in Vantaa separate spare part warehouse is maintained by the spare parts team. The enrichment process has worked efficiently in Shanghai that way. However one deficiency was spotted: the enrichment was done when a received order was stopped in ERP. The process is improved now to same as in Vantaa – the quotation engineers request the enrichment already when quoting the item. That increases on-time delivery even when the quoted delivery times are shorter than before.

The internal orders sent to Vantaa by sales offices are based on Product Data Management model. The information on standard items including the delivery time and the price are listed there to make the ordering process easier and faster. It lightens the quotation engineers' work load remarkably – roughly half of all the spare part items can be ordered without an internal quotation. PDM model for Shanghai was launched in September 2014. The included items consist of items with safety stock in the Shanghai warehouse – whether the item is used mainly as a spare part or to assemble a com-

plete unit. The spare part items in PDM with Shanghai delivery time will be added to the system continuously to offer better coverage of available items.

Spare Part	Description	GRP	Vantaa Shortest DT	Shanghai Shortest DT
H000383	SPARE PART SET BJ/B1J 8 C/CL EPICHLOROHYDRIN, ECO	327	0,4	1
H000384	SPARE PART SET BJ/B1J 12 C/CL EPICHLOROHYDRIN, ECO	512	0,4	1
H000385	SPARE PART SET BJ/B1J 20 C/CL EPICHLOROHYDRIN, ECO	859	0,4	1
H000386	SPARE PART SET BJ/B1J 25 C/CL EPICHLOROHYDRIN, ECO	1091	0,4	1
H000387	SPARE PART SET BJ/B1J 32 C EPICHLOROHYDRIN, ECO	1657	0,4	

Figure 14. Items in Product Data Management system.

The pricing principles are clear to everyone involved. The engineers in both factories price items that are priced according to the cost and can get a quotation from supplier. That leaves the cost plus value based items to be priced in Vantaa.

4.3.3 Ongoing issues and further improvements

3rd party items were created in the master database only in Vantaa and enriched first in the Vantaa warehouse before Shanghai could enrich it to their needs. The process needs the Shanghai engineers to contact Vantaa so there is one step that could be left away to make the process smoother. Understandably Shanghai started to slip and create items on their own without requesting the item to be created in Vantaa first. That led to a situation where orders were made to Vantaa for unrecognizable new items. ERP does not accept orders for items not enriched and if such items are ordered it is the Vantaa quotation engineers' task to enrich the item correctly. Ordered 3rd party items were created incorrectly in Shanghai, so Vantaa personnel were not able to recognize what has been ordered. To avoid such situations the rules have to be clearer; either Vantaa creates all the items or the Shanghai engineers have to be properly instructed and both offices would create the items. Currently there is no plan how to proceed but the situation will be discussed in the coming meetings between the offices. Also a new option came up on the discussions between the spare parts quotation engineers and the product management in Vantaa: It might be possible to outsource the whole process of creating of 3rd party items. That involves also other organizations and is not up to the spare parts to decide whether that option is used or not. Further study about feasibility of the option from spare parts point of view is not done yet but the first impression is positive.

Improvements on the process of the spare part quotations for the projects are still under work. One significant step is taken though: Simultaneously with this project a tool for the project quotations was created. ProXL is an excel file that looks up the recommended spare parts for the listed valve and actuator types. The quotation engineer has to list the type codes of the units received from the project unit on the file and ProXL searches the spare part recommendation including part id codes, descriptions, prices and delivery times from the master database. That database contains information only on the standard type codes – the special ones have to be looked up manually and items may even have to be created because some of the units quoted for the project might be newly designed. The ProXL tool has been in use in Vantaa for several months and most of the bugs and defects are already spotted and fixed. It was introduced in Shanghai on June 2014. The process for the project spare part quotations are still to be improved but work is made a bit easier already.

5 Discussion

Spare part deliveries have been historically done from Finland. Business has globalized and production facilities are spread to other continents as well, and local support is covered by several service centers. The company emphasizes the importance of service business, so it is only rational to offer spare parts also from other facilities besides Finland. Production and products are mostly similar in the Shanghai and Vantaa factories, so they are natural choices to offer similar service for spare parts.

Processes for spare part operations already existed before this project was started in 2013 but were not efficiently organized. The team is small and its history not long, so forming and shaping it is not a difficult job – arranging everything from far away with limited resources is maybe more challenging. The time needed to carry out the project has to be taken now and must be done also in the future to keep the standard of working high and develop the best practices continuously in both spare part teams.

After this project was started some important improvements in the Shanghai office quotation phase were made to help to reach the target. Shorter delivery times and better on-time delivery are the most important ones from the sales office point of view but internally even more important are the ones that help daily work. Standardized processes and clearer division of work between the offices create a good basis to build on the whole guidelines of quotation support. Now that the ground is created, it will be important to continue the work. Whenever new ways of working are taken into daily routines, it should be considered if it was needed to be done in both offices. Regular meetings between the teams are important occasions to keep everyone involved updated.

Implementing the processes into operation was relatively easy. The cultures are different but good co-operation between the teams helped the cause. Also in the future different cultural distances will keep the offices and working different, but a team's own identity might be only a good thing. The Asian office can probably serve Asian customers better, and two independent offices can develop processes and even create something new. It is essential to value different views of how to work. According to Markides (1998) successful strategic innovators have designed the appropriate environment that encourages and promotes a questioning attitude. As a result, continuous questioning of the status quo and continuous experimentation will just follow. All in all keeping the

best practices up to date will ensure that the high quality of work will remain the top priority.

Supply chain management plays a role in spare part operations decisions on how to arrange the quotation phase in the most efficient way. An article on Outcome-Driven Supply Chains gave some good views of what should be considered important and worthwhile bringing up (Melnyk & Davis & Spekman & Sandor, 2010). Most of the outcomes would be stronger if the quotation phase was divided between the two offices. Stronger presence nearer the customers would also be beneficial and two equal offices would make a difference in that sense.

The next phase is to grow the volume of the spare part deliveries from Shanghai and thereby the internal quotation inquiries. The target is that the spare part team in Shanghai would be able to handle quotations in the Asia-Pacific area independently. Currently many sales offices in the area still send inquiries to Vantaa like they have always done. To change attitudes toward using the Shanghai office might be a challenge. On the other hand service would probably be faster in terms of spare part deliveries and possibly technical back-up because of smaller workload. Decisions on how this will be promoted or on what kind of schedule have not been done yet. Currently the spare part team is well-prepared for more workload but the team is still considerably smaller than the team in Vantaa and therefore applying any rules on where each sales office must order spare parts should be considered carefully. One viable option could be to ask some certain sales offices to use only the Shanghai office if possible. In that way the workload from Asia-Pacific countries could be slowly moved from the Vantaa office to Shanghai.

In the long run the workload will be much higher than now in Shanghai if everything goes as planned. The Asia-Pacific market is a big and important one for the company. The potential for growth is high because growing economies commands large installed base of the Metso equipment and thus the need for service is growing. Also the need for quotation support will become much higher. Time will show if that growth can be handled with continuously advanced technical applications or if more personnel has to be hired.

6 Conclusion

The target beyond this project is that the Shanghai spare parts team would be able to serve the Asia-Pacific region spare part deliveries independently. The starting point of the project was to support the smaller and newer spare part team to create and develop their processes towards that target. The existing processes and ways of working in Finland were used as a guideline to all actions. Experience, used processes and the structure of the Vantaa team was considered to be a good basis to the Shanghai office as well and it was all sounded against the theory of Outcome-Driven Supply chains – the best practices to reach efficient ways of working as well as smart decisions business-wise was the desired result.

Theoretical basis of the project is supply chain management. Outcome-driven supply chains explain the idea of the future supply chains: a fast and cost-effective chain is not enough to succeed in tomorrow's business – you need all the six introduced outcomes to serve the customers well. Also security, resilience, responsiveness, innovation and sustainability should be considered for every customer. A different mix of all the six outcomes is needed to serve different customers.

The case company Metso Automation and especially Flow Control's Service business line targets strong growth in the coming years. That results in growing importance of the spare parts business. Traditionally it has been managed and deliveries made completely in Finland but globality of the business environment encourages to utilize other facilities as well. The facilities in Shanghai are quite new and its potential to serve the Asia-Pacific independently is attractive. The spare parts operations already existed but grounds for full use of it needed to be created. The processes and structure of the Vantaa team has evolved into an efficient unit and was a good basis to build on – the ways of working would be copied and modified to the Shanghai working culture and the team. Especially the quotation phase would be in scope of this thesis while the whole project would concentrate on improving the performance of the whole spare parts team in Shanghai.

The improvements on the quotation phase consist of standardizing the processes and finding the best practices for both offices. The main categories for the improvements are defining the delivery times, pricing, product data management and project quotations. The first two were clearly defined and settled during the course of project while

the latter two are still partially open issues. Product data management is mainly clear and focus for further discussion is on minor details. The project quotations are a subject that has risen to greater attention during the past years and the best practices are developed continuously.

As a result of the project acquirements of the Shanghai spare parts team are on much higher level than before. There is still some way to reach a level when they would be able to cover the Asia-Pacific region independently but growth of the market underlines the importance of the spare part team presence. Also the size of the team is not ready for such high volumes but is ready for a higher than current workload. How the workload will be moved from Vantaa to Shanghai remains to be decided. Development of the best practices will continue in both offices and therefore the future communication between the offices must be top priority. Further development in different cultures and working environments can result in new innovative and useful ideas that can be used globally.

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